

74AHC138; 74AHCT138

3-to-8 line decoder/demultiplexer; inverting

Rev. 7 — 29 February 2024

Product data sheet

1. General description

The 74AHC138; 74AHCT138 are high-speed Si-gate CMOS devices and are pin compatible with Low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard No. 7A.

The 74AHC138; 74AHCT138 is a 3-to-8 line decoder/demultiplexer. It accepts three binary weighted address inputs (A0, A1 and A2) and, when enabled, provides eight mutually exclusive outputs ($\bar{Y}0$ to $\bar{Y}7$) that are LOW when selected.

There are three enable inputs: two active LOW ($\bar{E}1$ and $\bar{E}2$) and one active HIGH (E3). Every output will be HIGH unless $\bar{E}1$ and $\bar{E}2$ are LOW and E3 is HIGH.

This multiple enable function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four 74AHC138; 74AHCT138 devices and one inverter. The 74AHC138; 74AHCT138 can be used as an eight output demultiplexer by using one of the active LOW enable inputs as the data input and the remaining enable inputs as strobes. Unused enable inputs must be permanently tied to their appropriate active HIGH or LOW state.

2. Features and benefits

- Balanced propagation delays
- All inputs have Schmitt-trigger action
- Demultiplexing capability
- Multiple input enable for easy expansion
- Ideal for memory chip select decoding
- Inputs accepts voltages higher than V_{CC}
- For 74AHC138 only: operates with CMOS input levels
- For 74AHCT138 only: operates with TTL input levels
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74AHC138D 74AHCT138D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74AHC138PW 74AHCT138PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74AHC138BQ 74AHCT138BQ	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1

4. Functional diagram

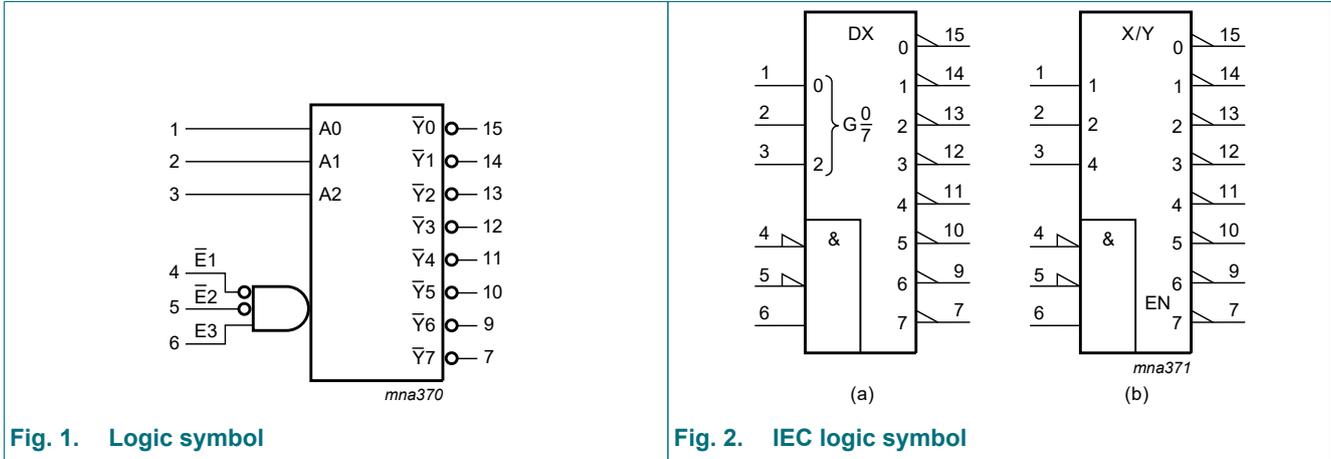


Fig. 1. Logic symbol

Fig. 2. IEC logic symbol

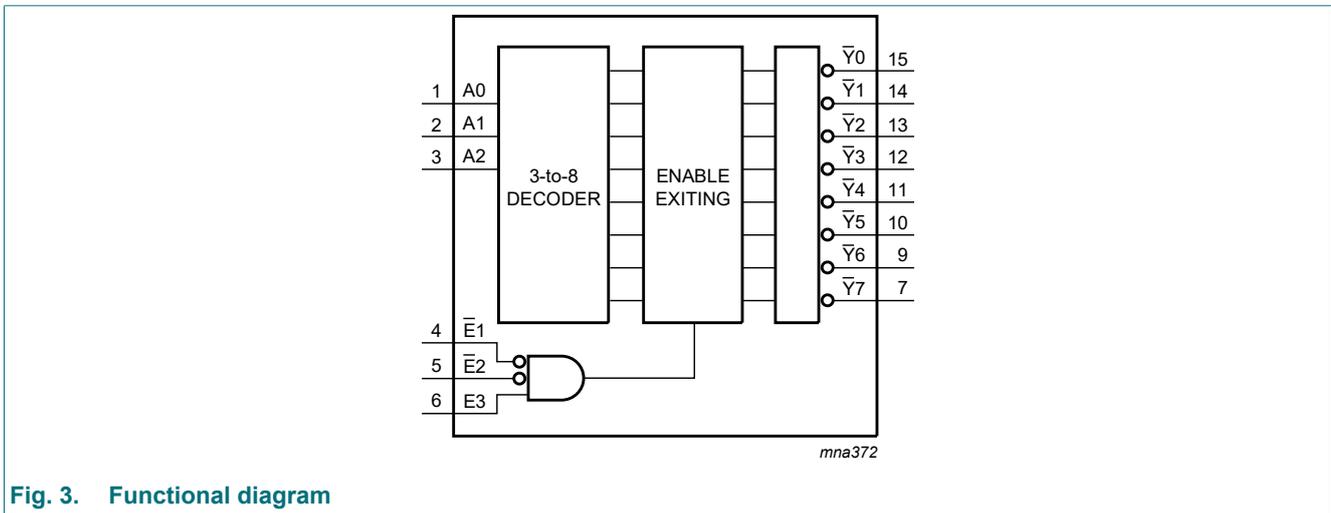
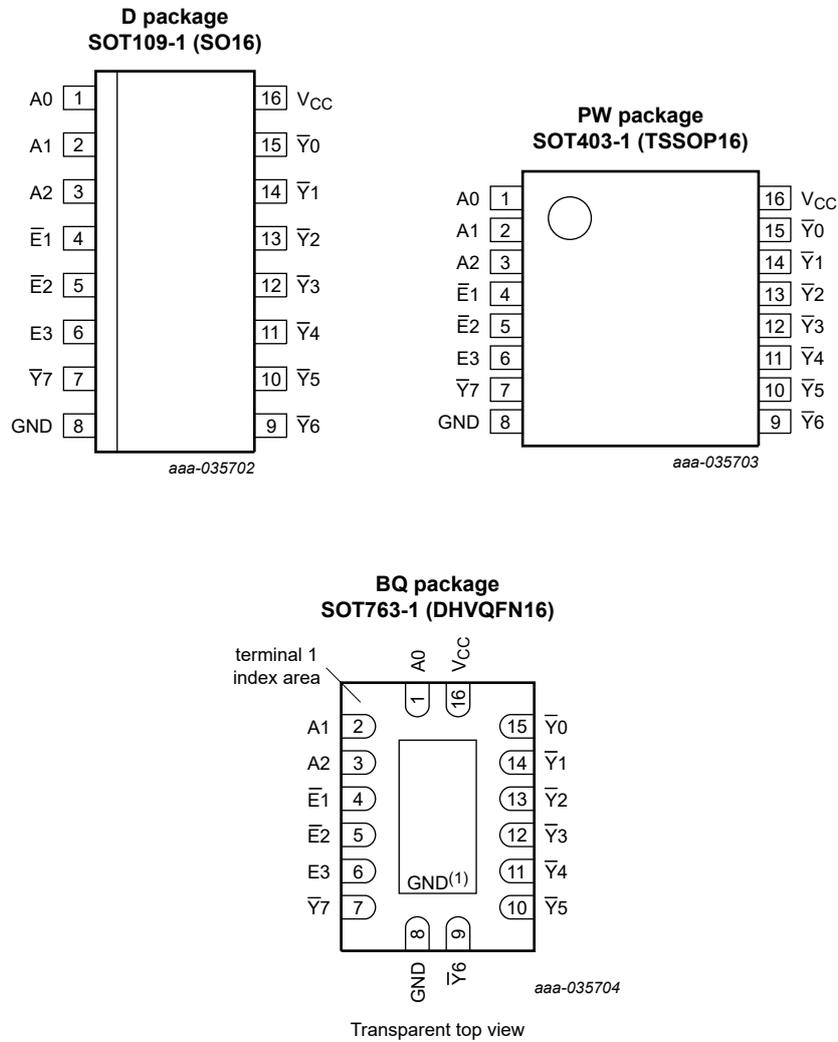


Fig. 3. Functional diagram

5. Pinning information

5.1. Pinning



(1) This is not a ground pin. There is no electrical or mechanical requirement to solder the pad. In case soldered, the solder land should remain floating or connected to GND.

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
A0	1	address input
A1	2	address input
A2	3	address input
$\bar{E}1$	4	enable input (active LOW)
$\bar{E}2$	5	enable input (active LOW)
E3	6	enable input (active HIGH)
GND	8	ground (0 V)
$\bar{Y}0, \bar{Y}1, \bar{Y}2, \bar{Y}3, \bar{Y}4, \bar{Y}5, \bar{Y}6, \bar{Y}7$	15, 14, 13, 12, 11, 10, 9, 7	output
V _{CC}	16	supply voltage

6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

Input						Output							
$\bar{E}1$	$\bar{E}2$	$\bar{E}3$	A0	A1	A2	$\bar{Y}0$	$\bar{Y}1$	$\bar{Y}2$	$\bar{Y}3$	$\bar{Y}4$	$\bar{Y}5$	$\bar{Y}6$	$\bar{Y}7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+7.0	V
V_I	input voltage		-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V [1]	-20	-	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V [1]	-	± 20	mA
I_O	output current	$V_O = -0.5$ V to $(V_{CC} + 0.5$ V)	-	± 25	mA
I_{CC}	supply current		-	75	mA
I_{GND}	ground current		-75	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C [2]	-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For SOT109-1 (SO16) package: P_{tot} derates linearly with 12.4 mW/K above 110 °C.
 For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
 For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	74AHC138			74AHCT138			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
V_I	input voltage		0	-	5.5	0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.3$ V \pm 0.3 V	-	-	100	-	-	-	ns/V
		$V_{CC} = 5.0$ V \pm 0.5 V	-	-	20	-	-	20	ns/V

9. Static characteristics

Table 6. Static characteristics

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74AHC138										
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0$ V	1.5	-	-	1.5	-	1.5	-	V
		$V_{CC} = 3.0$ V	2.1	-	-	2.1	-	2.1	-	V
		$V_{CC} = 5.5$ V	3.85	-	-	3.85	-	3.85	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0$ V	-	-	0.5	-	0.5	-	0.5	V
		$V_{CC} = 3.0$ V	-	-	0.9	-	0.9	-	0.9	V
		$V_{CC} = 5.5$ V	-	-	1.65	-	1.65	-	1.65	V

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -50 µA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -50 µA; V _{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I _O = -50 µA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4.0 mA; V _{CC} = 3.0 V	2.58	-	-	2.48	-	2.4	-	V
		I _O = -8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.8	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 50 µA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V or 5.5 V	-	-	0.1	-	1.0	-	2.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	4.0	-	40	-	80	µA
C _I	input capacitance		-	3.0	10	-	10	-	10	pF
74AHCT138										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = -50 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -8.0 mA	3.94	-	-	3.8	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 50 µA	-	0	0.1	-	0.1	-	0.1	V
		I _O = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V or 5.5 V	-	-	0.1	-	1.0	-	2.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	4.0	-	40	-	80	µA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other pins at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C _I	input capacitance		-	3.0	10	-	10	-	10	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; for test circuit see Fig. 6.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
74AHC138										
t _{pd}	propagation delay	An to \bar{Y}_n ; see Fig. 4 [2]								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	6.0	11.4	1.0	13.0	1.0	14.5	ns
		C _L = 50 pF	-	8.6	15.8	1.0	18.0	1.0	20.0	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.4	8.1	1.0	9.5	1.0	10.5	ns
		C _L = 50 pF	-	6.3	10.1	1.0	11.5	1.0	13.0	ns
		E3 to \bar{Y}_n ; see Fig. 4 [2]								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.8	12.8	1.0	15.0	1.0	16.0	ns
		C _L = 50 pF	-	8.2	16.3	1.0	18.5	1.0	20.5	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.2	8.1	1.0	9.5	1.0	10.5	ns
		C _L = 50 pF	-	6.0	10.1	1.0	11.5	1.0	13.0	ns
		$\bar{E}1, \bar{E}2$ to \bar{Y}_n ; see Fig. 5 [2]								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.7	11.4	1.0	13.5	1.0	14.5	ns
		C _L = 50 pF	-	8.2	14.9	1.0	17.0	1.0	19.0	ns
V _{CC} = 4.5 V to 5.5 V										
C _L = 15 pF	-	4.2	8.1	1.0	9.5	1.0	10.5	ns		
C _L = 50 pF	-	6.0	10.1	1.0	11.5	1.0	13.0	ns		
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _i = GND to V _{CC} [3]	-	18.0	-	-	-	-	-	pF
74AHCT138										
t _{pd}	propagation delay	An to \bar{Y}_n ; see Fig. 4 [2]								
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.4	10.4	1.0	12.0	1.0	13.0	ns
		C _L = 50 pF	-	6.2	11.4	1.0	13.0	1.0	14.5	ns
		E3 to \bar{Y}_n ; see Fig. 4 [2]								
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.3	9.1	1.0	10.5	1.0	11.5	ns
		C _L = 50 pF	-	6.2	10.1	1.0	11.5	1.0	13.0	ns
		$\bar{E}1, \bar{E}2$ to \bar{Y}_n ; see Fig. 5 [2]								
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.3	9.6	1.0	11.0	1.0	12.0	ns
		C _L = 50 pF	-	6.2	10.6	1.0	12.0	1.0	13.5	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
C _{PD}	power dissipation capacitance	C _L = 50 pF; f _i = 1 MHz; V _I = GND to V _{CC} [3]	-	23.0	-	-	-	-	-	pF

- [1] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V and V_{CC} = 5.0 V).
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz, f_o = output frequency in MHz
 C_L = output load capacitance in pF
 V_{CC} = supply voltage in V
 N = number of inputs switching
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

10.1. Waveforms and test circuit

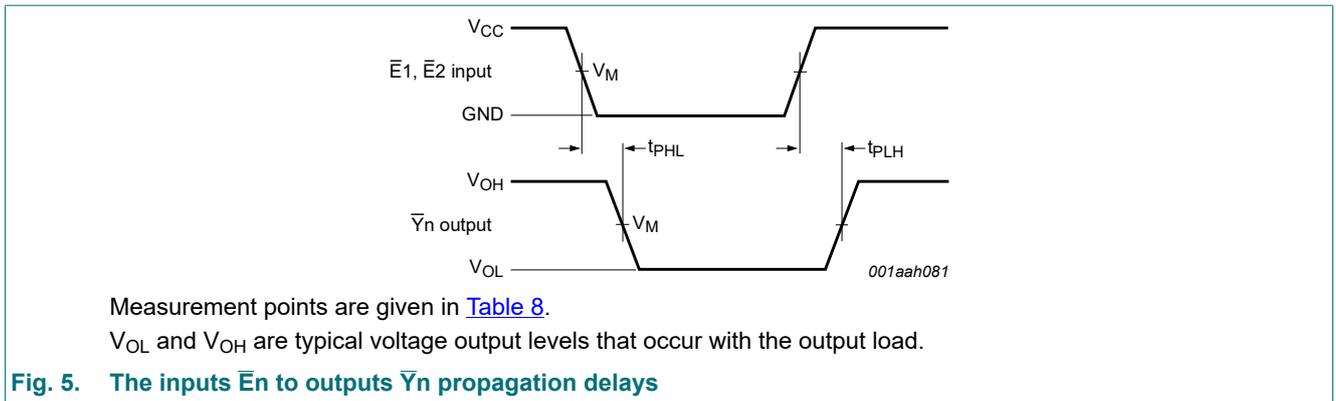
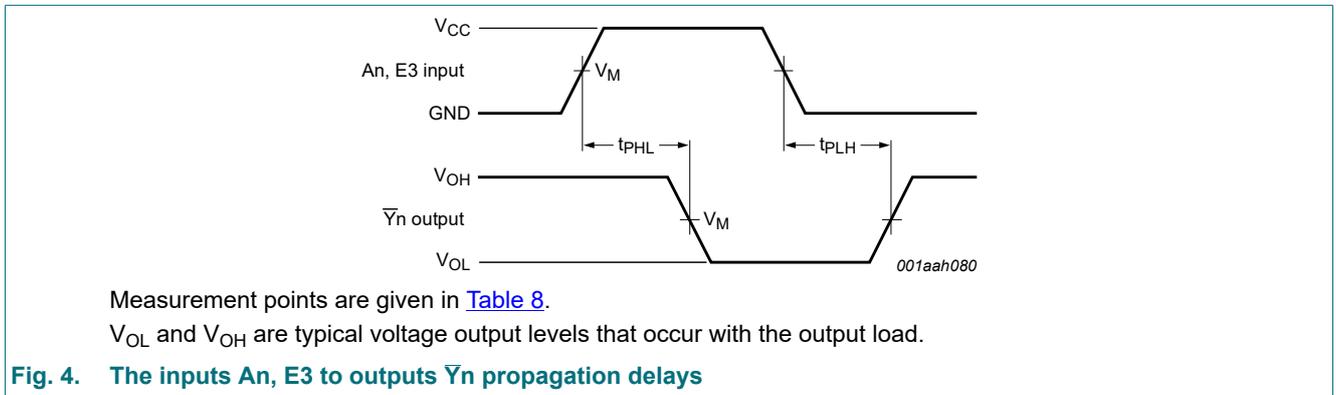


Table 8. Measurement points

Type	Input	Output
	V _M	V _M
74AHC138	0.5 × V _{CC}	0.5 × V _{CC}
74AHCT138	1.5 V	0.5 × V _{CC}

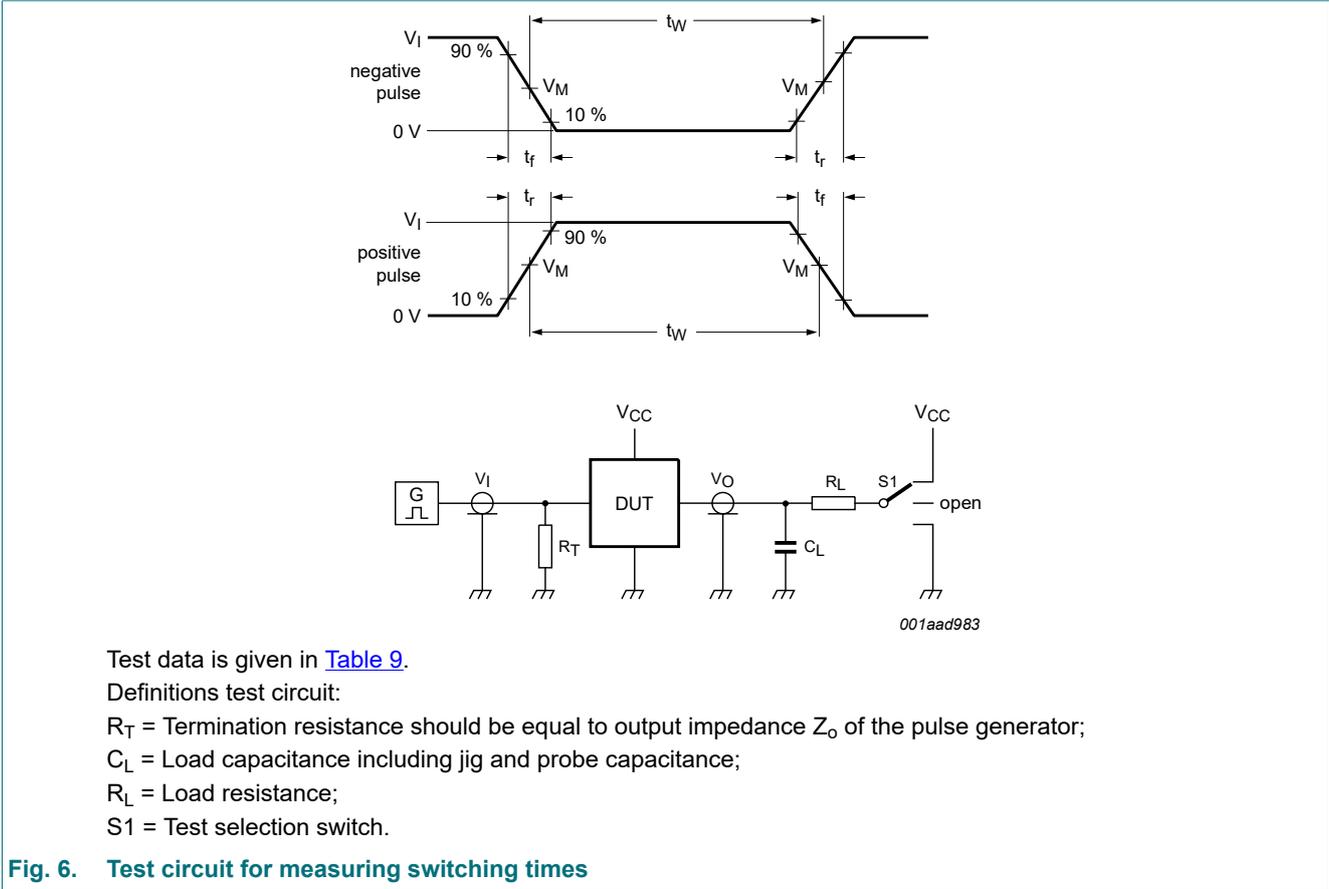


Fig. 6. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74AHC138	V_{CC}	≤ 3.0 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}
74AHCT138	3.0 V	≤ 3.0 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

11. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

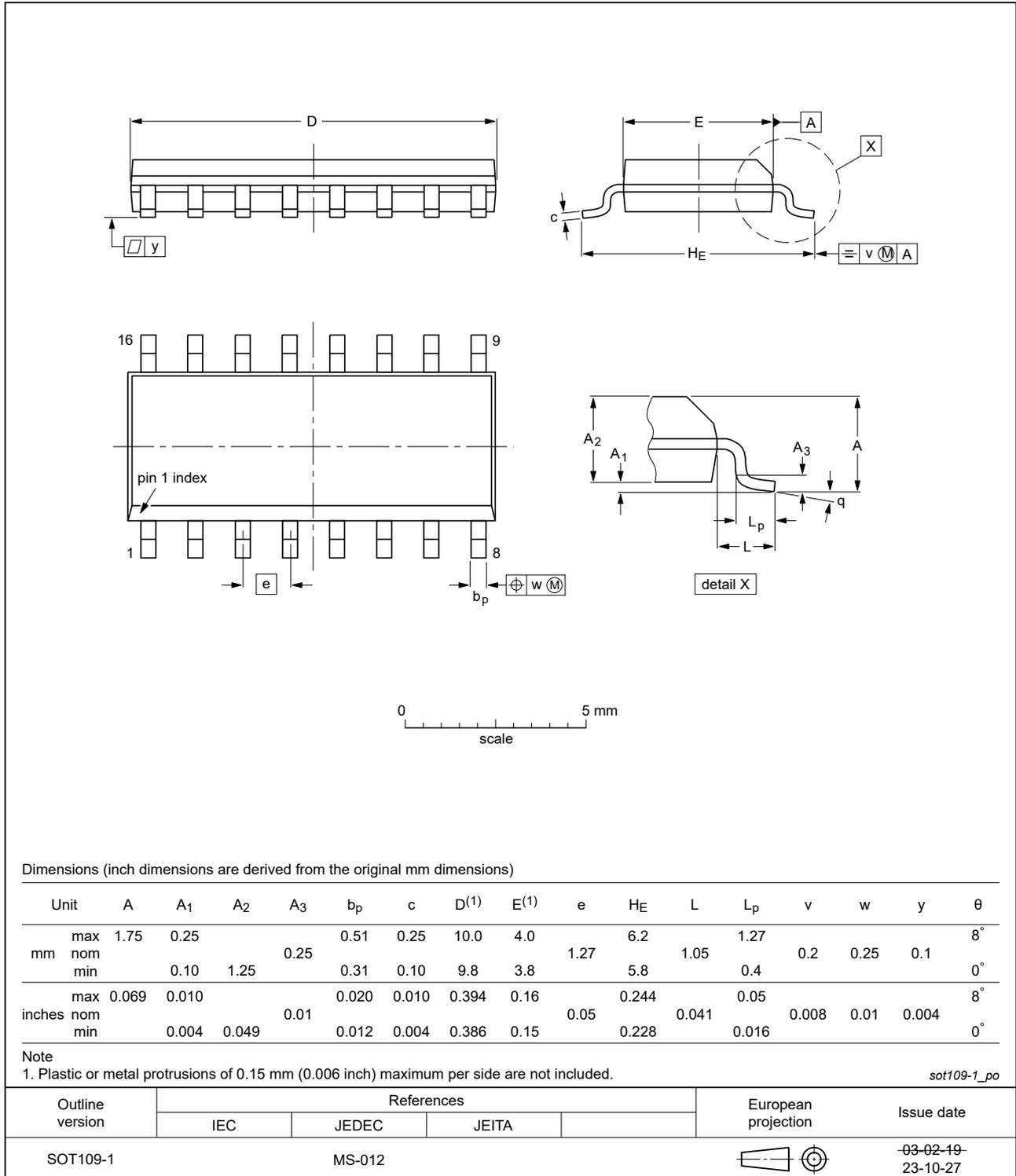


Fig. 7. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

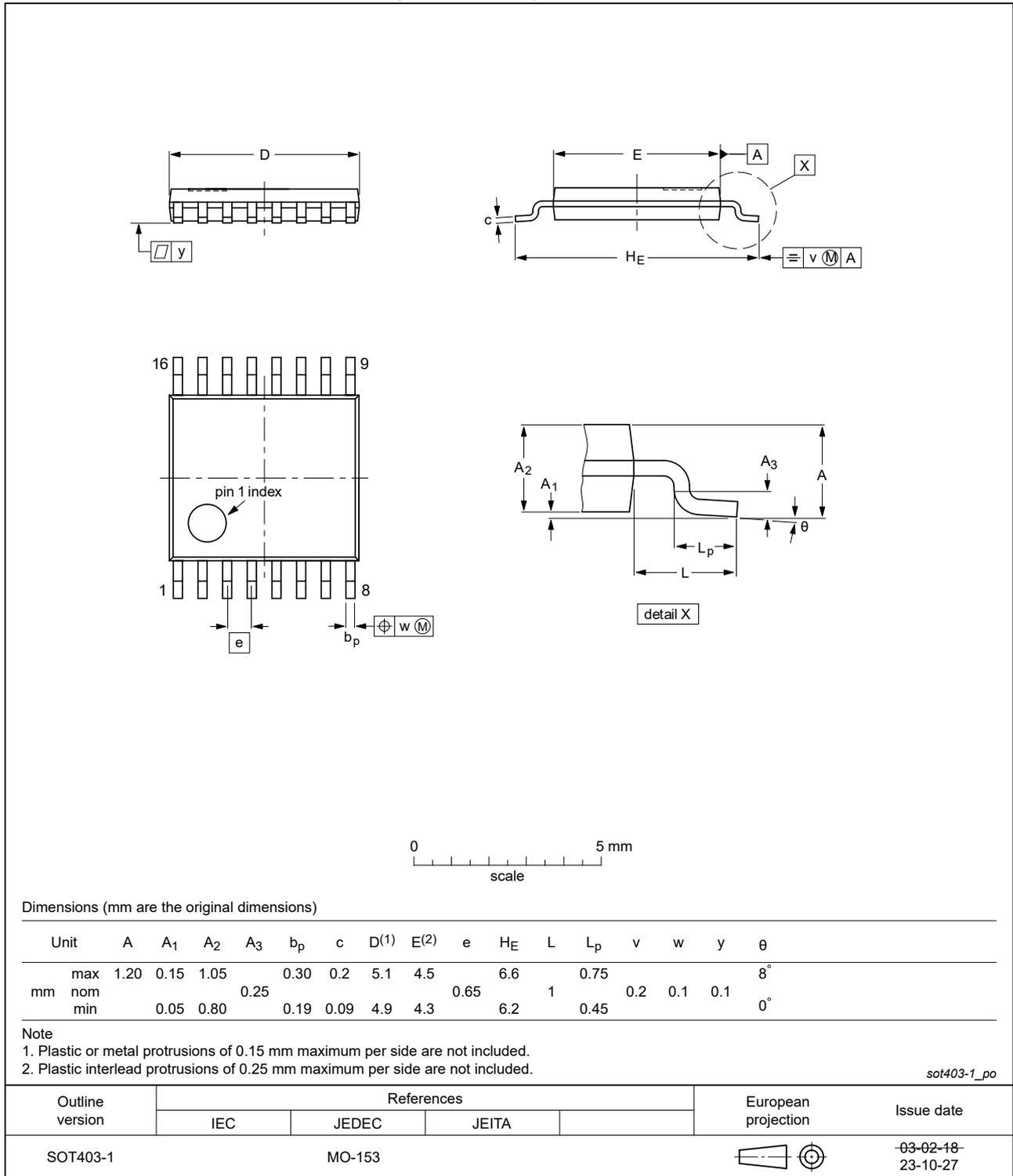


Fig. 8. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

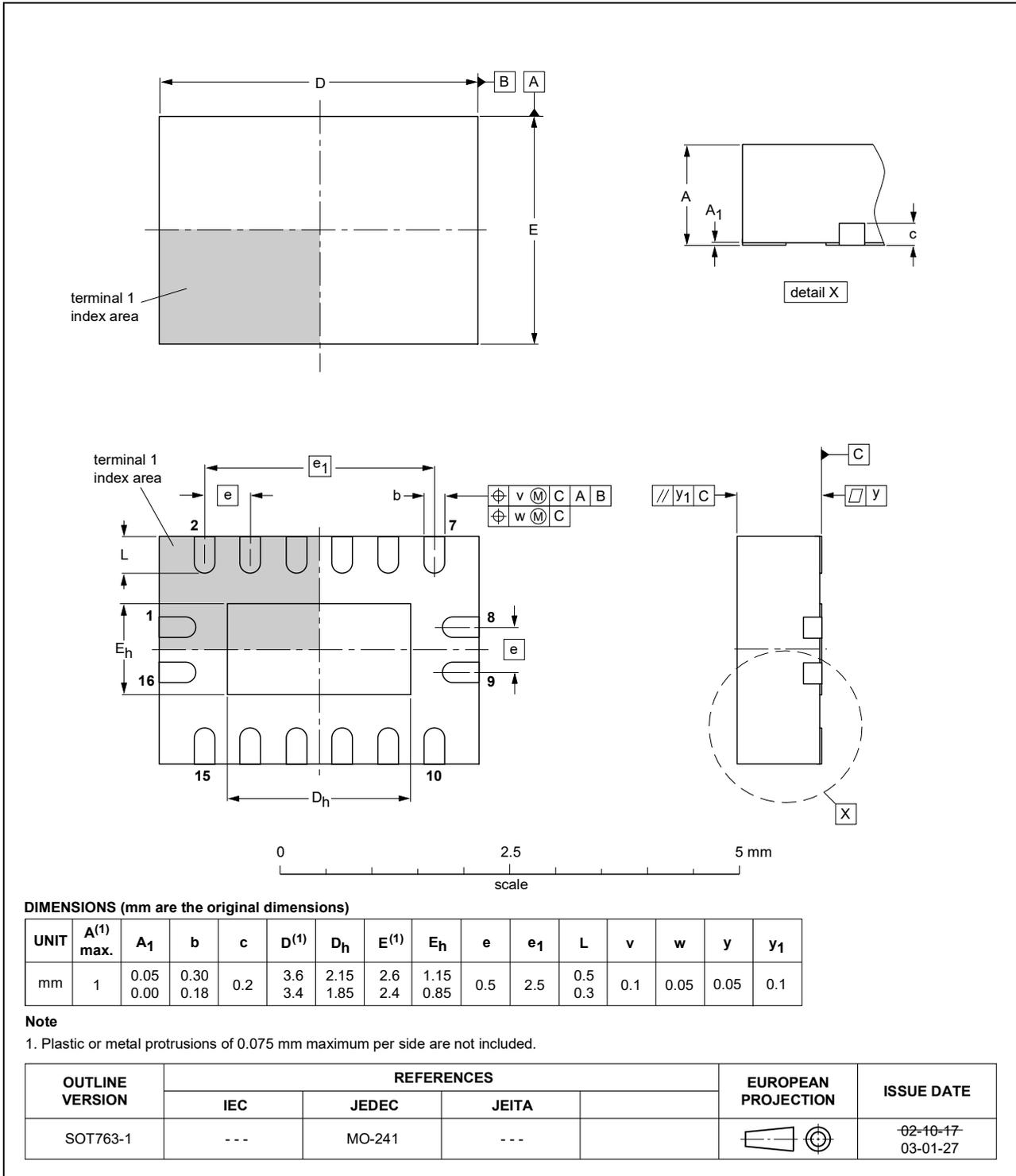


Fig. 9. Package outline SOT763-1 (DHVQFN16)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged-Device Model
CMOS	Complementary Metal Oxide Semiconductor
LSTTL	Low-power Schottky Transistor-Transistor Logic
ESD	ElectroStatic Discharge
HBM	Human Body Model
TTL	Transistor-Transistor Logic

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT138 v.7	20240229	Product data sheet	-	74AHC_AHCT138 v.6
Modifications:	<ul style="list-style-type: none"> Fig. 7, Fig. 8: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153. 			
74AHC_AHCT138 v.6	20230904	Product data sheet	-	74AHC_AHCT138 v.5
Modifications:	<ul style="list-style-type: none"> Section 2: ESD specification updated according to the latest JEDEC standard. 			
74AHC_AHCT138 v.5	20200910	Product data sheet	-	74AHC_AHCT138 v.4
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Table 4: Derating values for P_{tot} total power dissipation have been updated. 			
74AHC_AHCT138 v.4	20140402	Product data sheet	-	74AHC_AHCT138 v.3
Modifications:	<ul style="list-style-type: none"> Description for t_{pd} for the 74AHCT138 corrected (errata) in Table 7 			
74AHC_AHCT138 v.3	20071128	Product data sheet	-	74AHC_AHCT138 v.2
74AHC_AHCT138 v.2	19990927	Product specification	-	74AHC_AHCT138 v.1
74AHC_AHCT138 v.1	19900331	Product specification	-	-

14. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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For more information, please visit: <http://www.nexperia.com>
For sales office addresses, please send an email to: salesaddresses@nexperia.com
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